REPRODUCTIVE SUCCESS AND HABITAT REQUIREMENTS OF THE SOUTHWESTERN WILLOW FLYCATCHER IN THE CLIFF-GILA VALLEY, NEW MEXICO

Final Report for the 1999 Field Season

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EXECUTIVE SUMMARY

Due to a strong La Niña pattern, 1999 was a year of weather extremes in the Cliff-Gila Valley. An extended and windy drought lasting from autumn of 1998 through June 1999 was finally broken by exceptionally heavy monsoon rains beginning in late June. This adverse weather appeared to have a negative impact on nest success of Willow Flycatchers. In 1999, we located 146 flycatcher nests. Of these, 92 were known to have failed. Many early nests were either damaged by wind or abandoned prior to egg-laying. Excluding those known to have been abandoned prior to laying, simple nest success was about 33%, well below the levels recorded in 1997-98. Anecdotal observations suggest that this low level of per-nest success may reflect a high incidence of multiple nesting attempts per pair. Estimated rates of cowbird parasitism were 15.6 %, the lowest recorded in the three years of this study. Predation was the most frequent cause of nest failure for nests where causes were known.

As in previous years, flycatchers nested most frequently and preferentially in box elder. They tended to avoid willow except in mostly pure stands of either coyote or Goodding's willow. We recorded the first known nests placed in canyon grape and the exotic Siberian elm. Flycatchers placed their nests high (mean = 7.5 m). The average relative height of nests within the nest plant was 63.9%, almost the same as the relative height in native plants in Arizona and for the eastern subspecies (*E. t. traillii*) in shrubby habitats in Wisconsin. This congruence suggests relative nest height, rather than absolute height, may be of importance to Willow Flycatchers.

Although not experimental tests, we were able to assess the effects on flycatchers of grazing and irrigation as practiced on the U Bar Ranch by comparing data from patches that were grazed versus not grazed, and patches that were on or not on a ditch. Grazing had no apparent impact (positive or negative) on flycatcher density, nest success, or cowbird parasitism. In contrast, flycatchers appeared to benefit from irrigation: they occurred in significantly higher densities in patches associated with irrigation ditches.

INTRODUCTION

The Species. — The Southwestern Willow Flycatcher *(Empidonax traillii extimus)* is a neotropical migrant passerine that ranges from southern California and Baja California eastward through Arizona, southern Utah, southern Colorado, New Mexico, and trans-Pecos Texas (Unitt 1987). This species is an obligate riparian specialist, nesting in dense vegetation associated with watercourses. In the southwest, nesting is almost always in the vicinity of surface water or saturated soils (U.S. Fish and Wildlife Service 1995).

Populations of the southwestern willow flycatcher are thought to have declined significantly during this century, primarily due to extensive loss and conversion of riparian breeding habitats (Unitt 1987, U.S. Fish and Wildlife Service 1995). Loss and modification of riparian habitats have been attributed to many factors, including water diversion and impoundment, changes in fire and flood frequency due to hydrological alterations, livestock overgrazing, replacement of native riparian vegetation by nonnative species, urban development, and recreational activities (Rea 1983, Kreuper 1993, U.S. Fish and Wildlife Service 1995). Additionally, a high incidence of nest parasitism by brown-headed cowbirds (*Molothrus ater*) has been reported from several sites, resulting in low reproductive success. Cowbirds lay their eggs in the nests of other species (hosts), where cowbird chicks are raised by the host parents. For small hosts, parasitized nests rarely fledge any host young (Brittingham & Temple 1983). Nest parasitism levels of more than 50% have been documented for populations at the Kern River, California (Harris 1991) and the Grand Canyon (Brown 1994). Frequently flycatchers respond to the laying of cowbird eggs in their nests by abandoning and renesting (Whitfield & Strong 1995).

In 1993, the U.S. Fish and Wildlife Service proposed to list *E. t. extimus* as an endangered species and to designate critical habitat. In February of 1995, the USFWS listed *E. t. extimus* as endangered, although no designation of critical habitat was made (U.S. Fish and Wildlife Service 1995). The subspecies has also been listed at the state level in New Mexico, Arizona, and California (Arizona Game and Fish Department 1988, New Mexico Department of Game and Fish 1988, California Department of Fish and Game 1992).

The Cliff-Gila Valley population. — Since its listing as an endangered species, numerous surveys have been conducted across the range of the flycatcher to locate extant populations and to estimate their size. Flycatchers have been found breeding at about 109 sites throughout the southwestern United States (Finch 1999). Approximately 78% of extant sites consist of 5 or fewer territories. The entire known breeding population in 1996 was estimated at just over 500 pairs (Finch 1999). By far the largest known breeding concentration of Southwestern Willow Flycatchers is located in the Cliff-Gila Valley, Grant County, New Mexico. This population was estimated at 184 pairs in 1997 (Parker 1997), and at 235 pairs in 1998 (P. Boucher, personal communication; Stoleson and Finch, unpublished data). These birds are located primarily on private property owned by the Pacific Western Land Company, a subsidiary of Phelps Dodge Corporation, and managed by the U-Bar Ranch. An additional 33 pairs occur on the adjacent Gila National Forest and other private holdings. Habitat preferences of flycatchers in this population differ, at least superficially, from those reported elsewhere (Hull and Parker 1995, Skaggs 1996, Stoleson and Finch 1997), and from populations of other subspecies.

OBJECTIVES

Our goals for this study in 1999 were:

1. locate and monitor nests of Willow Flycatchers to assess levels of nesting success, cowbird parasitism and predation.
2. characterize and quantify vegetation at nests sites, territories, and unused sites within occupied habitat patches.
3. band adult and nestling Willow Flycatchers to allow individual identification.

This report presents the results of the third year of the study.

METHODS

Study area. — The Cliff-Gila Valley of Grant County, NM, comprises a broad floodplain of the Gila River, beginning near its confluence with Mogollon Creek and extending south-southwest toward the Burro Mountains. The study was primarily conducted from just below the US Route 180 bridge upstream to the north end of the U-Bar Ranch (approximately 5 km). In addition, flycatchers were studied in two disjunct sections of the valley: (1) the Fort West Ditch site of the Gila National Forest and adjacent holdings of The Nature Conservancy's Gila Riparian Preserve, located about 9 km upstream of the Route 180 bridge, and (2) the Gila Bird Area, a riparian restoration project comprising lands of the Gila National Forest and Pacific-Western Land Company, located some 8 km downstream of the Route 180 bridge. Most of the upper Gila Valley consists of irrigated and non-irrigated pastures used for livestock grazing and hay farming. Elevations range from 1350 to 1420 m.

The Gila River and nearby earthen irrigation ditches are lined with riparian woodland patches of various ages and composition. Most patches support a mature woodland (>25 m canopy) of Fremont cottonwood (*Populus fremontii*), with a subcanopy of mixed deciduous trees including box elder (*Acer negundo*), Goodding's willow (*Salix gooddingii*), velvet ash (*Fraxinus velutinus*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), Arizona alder (*Alnus oblongifolia*) and Russian olive (*Elaeagnus angustifolia*). The understory is composed of shrubs including three-leaf sumac (*Rhus trilobata*), false indigo (*Amorpha fruticosa*), New Mexico olive (*Forestieria neomexicana*), forbs, and grasses. Fewer patches support a shrubby, early successional growth of seepwillow (*Baccharis glutinosa*), coyote and bluestem willows (*Salix exigua* and *S. irrorata*), and saplings of the species mentioned above. Most habitat patches are less than 5 ha in area. The FS Fort West Ditch site and the Gila Bird Area are generally more open than patches on the U-Bar. In addition to the primary patches of riparian woodland along the Gila itself, numerous stringers of riparian vegetation extend along many of the earthen irrigation ditches. These stringers contain the same plant species as larger forest patches, but rarely exceed 10 m in width.

This study concentrated on three large riverine patches and two stringer patches on the U-Bar Ranch (see Fig. 1: SE1, NW1, NE1, SW Stringer, and NW Stringer) and the FS Fort West Ditch site. In addition, flycatchers were studied in other riparian patches as time allowed.

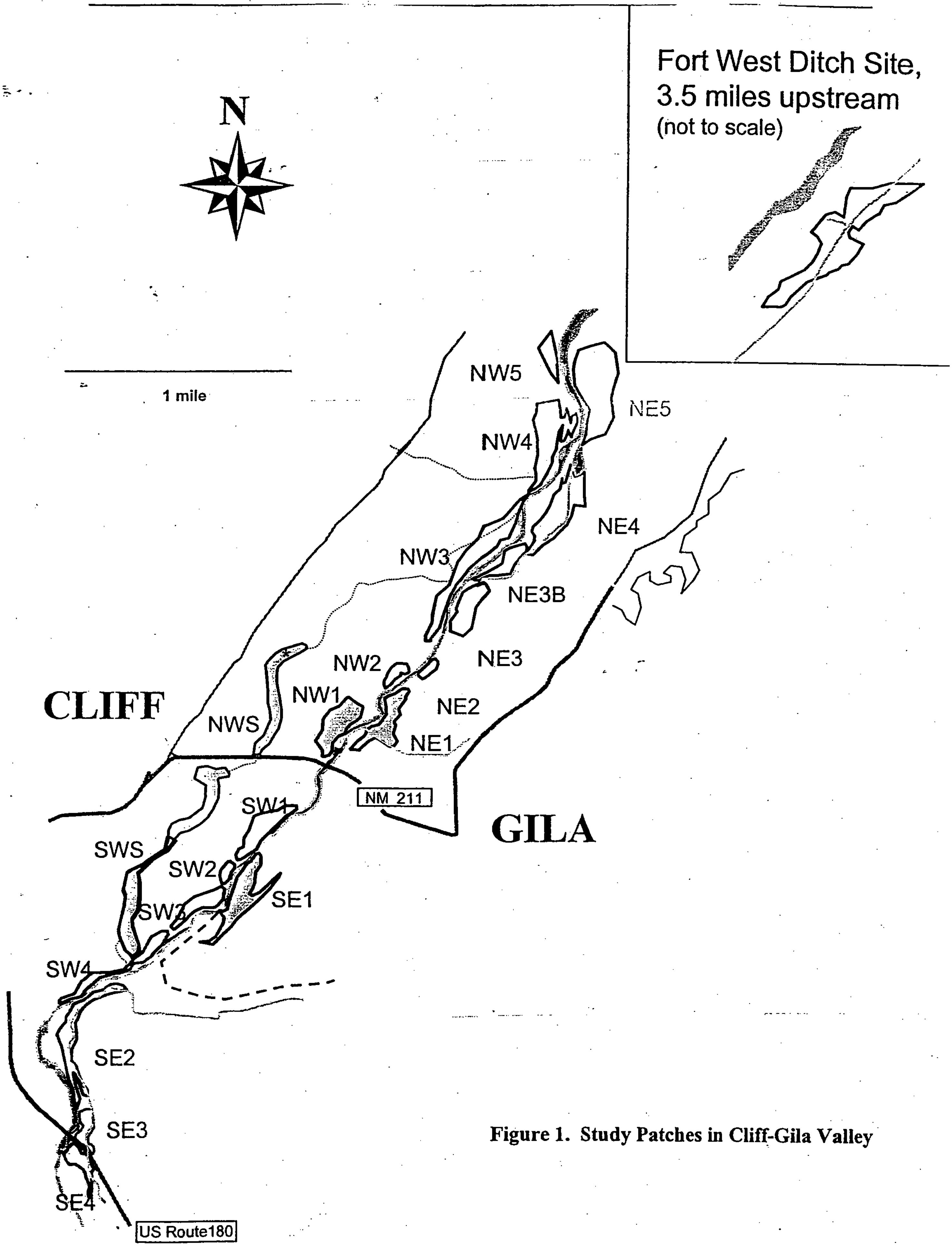

Figure 1. Study Patches in Cliff-Gila Valley

Spot mapping. — Territories of all breeding land birds were determined using the spot mapping method (Robbins 1970, Bibby et al. 1992, Ralph et al. 1993). In each focal patch, a grid of 100 ft squares was established and marked with flagging tape. We conducted spot-mapping censuses within each grid every 2-3 days, beginning within 15 minutes of dawn (Bibby et al. 1992). Following mapping, observations were transferred from the daily map to master maps for each species. From the master maps we determined the number of breeding territories of all species for each patch. We calculated estimates of the density of breeding birds (all species) for the areas that were spot-mapped. Because the territories of large and/or wide-ranging birds (e.g., quail, raptors, crows, ravens, swallows, jays, and cuckoos) could potentially cover two or more patches and/or surrounding nonforested land, a territory was assigned to a particular patch only if the nest was located within the patch. Second, Mourning Doves (*Zenaida macroura*) breed in high densities in riparian habitats but forage mainly in open areas. Because including all doves found in a patch in calculations is likely to bias estimates of density, we followed Anderson et al. (1983) in using only 10% of the observed dove population.

Nest monitoring. — Nest searches were conducted on a daily basis following spot-mapping sessions. Within focal patches, searches were conducted for nests of all species. Only flycatcher and cuckoo nests were searched for in additional patches. Nests were monitored every 3-7 days, following a modified version of proposed protocols suggested by the Arizona Game and Fish Department (Rourke et al. 1999). Nest contents were observed using pole-mounted mirrors or videocameras, or 15X spotting scopes. Nests that were abandoned or destroyed were examined for evidence (e.g., cowbird eggs, mammal hairs) to ascertain causes of nest failure. We considered a nest successful if: (1) parent birds were observed feeding one or more fledged young; (2) parent birds behaved as if dependent young were nearby when the nest was empty (defensive or agitated behavior near nest); or (3) nestlings were in the nest within one or two days of the estimated fledge date. We considered a nest failed if: (1) nest contents disappeared before fledging of young was possible, assuming 10-12 d required for fledging (depredation), (2) the nest contained no Willow Flycatcher young but contained cowbird eggs or chicks (parasitized), (3) the nest was deserted after eggs had been laid (desertion), or (4) the nest was abandoned prior to egg laying (abandonment).

Habitat Measurements. — We continued sampling vegetation at flycatcher nests and unused points within the focal patches in 1999, using a modified BBIRD methodology (Martin et al. 1997). Unused points were defined as points on the spot-mapping grid that were at least 100 ft away from the nearest Willow Flycatcher nest; we based this definition on the fact that most flycatcher territories appeared to have radii much smaller than 100 ft. At each unused point and nest site, a 0.02 ha plot (radius = 8 m) was placed centered on the nest tree, or on the nearest tree to the gridpoint for unused points. At the center of the plot and eight other points (4 and 8 m from the center in each of the four cardinal directions), we measured canopy height using clinometers, percent canopy cover using densiometers, and estimated percent ground cover. Vertical foliage density was measured at 2, 4, 6 and 8 m in each direction from the center tree by counting hits of vegetation against a 10 m vertical pole marked in 1 m increments. Within the 0.02 ha plot, trees (≥ 10 cm dbh) of all species were counted and measured (dbh). Shrubs and saplings (< 10 cm dbh) were counted and measured within a 4 m radius of the center tree. For nest sites we also recorded nest plant species, nest height, and distance, direction from the trunk.

For each sample point we calculated average ground and canopy cover and average canopy height (all = mean of 9 measurements per point); foliage density index (sum of 1 m increments touched by foliage) for understory (0-3 m in height, for a maximum score of 48 per point) and mid-canopy (3-10 m in height, for a maximum score of 112 per point); the sum of shrub/sapling (<10 cm diameter) stems and tree (≥ 10 cm diameter) stems by species and size class (<1cm, 1-5 cm, 5-7.5 cm, 7.5-10 cm, 10-30 cm, 30-50 cm, 50-70 cm, >70 cm). From these values we also calculated the total number of stems of willow and box elder per point, an estimate of the total basal area of woody species per point, woody plant species richness (number of species of trees and shrubs per point), and plant species diversity (using the Shannon-Weiner Diversity Index). We calculated several variables to estimate the degree of habitat heterogeneity at points: patchiness (the diversity of foliage density among the four cardinal directions, using the Shannon-Weiner Diversity Index); and the coefficient of variation in measures of canopy cover, canopy height, and ground cover at each point.

Analyses. — We compared habitat values of unused points (n=89) to those at nest sites (n=127) using independent sample t-tests when data were normally distributed, or Mann-Whitney U-Tests when they were not. Although we performed multiple statistical comparisons from the single set of data, we did not adjust our experiment-wise alpha level to minimize the risk of Type I errors because the modest sample sizes used for unused points are already prone to Type II errors, and we wanted to maximize our ability to detect trends. Those variables found to differ significantly between unused and nest points were included in a logistic regression analysis. When high correlation between pairs of variables suggested problems of collinearity, we dropped the variable we considered to be less biologically relevant. We chose as a final regression model that which explained the greatest deviance with the least number of parameters; we used likelihood-ratio tests between nested models to assess the explanatory power of individual variables (Menard 1995).

To assess whether flycatchers used nest substrates randomly, we calculated an index of availability for each nest tree species to compare usage with availability. Because flycatcher nests were found in vegetation of all size classes 1 cm DBH and greater, we pooled all size classes > 1 cm DBH as potential nest substrates. A total stem count for each species was calculated from all nest sites. The relative availability of a particular plant species *x* was calculated as: total number of stems for species *x* / total number of all stems. The numbers of used versus unused stems were compared using chi-square analyses.

RESULTS & DISCUSSION

CLIMATE IN 1999

Due to a strong La Niña pattern, 1999 proved to be a year of weather extremes in the Cliff-Gila Valley (Table 1). Severe drought began in late 1998 and persisted into June. Precipitation remained less than 30% of normal during this time, and water levels were very low in the Gila River. By late May, water flow in the Gila and Fort West irrigation ditches became irregular. Strong winds typical of early spring lasted well into June (pers. observation). Monsoon rains began earlier than normal in mid-June, and became torrential in July. Sufficient rain fell in July (182% of normal for the month) to make up for the water deficit of the previous 10 months. It seems likely that the extreme wind and drought followed by heavy rains had a negative impact on reproductive success of Willow Flycatchers in the area.

Table 1. Precipitation measured at Cliff, NM for January-August 1999, compared to averages for 1936-1999. Data are from the Western Regional Climate Center.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
1999 precipitation (in.)	0.11	0.00	0.35	0.39	0.08	0.93	5.09[a]	1.88
Average precipitation (1936-1999)	1.01	0.96	0.86	0.33	0.36	0.50	2.79	2.84
Deviation from normal (in.)	-0.90	-0.96	-0.51	0.06	-0.28	0.43	2.30	-0.96
Cumulative deviation from normal	-0.90	-1.86	-2.37	-2.31	-2.59	-2.16	0.14	-0.82
Expected cumulative total	1.01	1.97	2.83	3.16	3.52	4.02	6.81	9.65
% of normal (cumulative)	10.9	5.6	16.3	26.9	26.4	46.3	102.1	91.5

[a] data set is missing one day.

WILLOW FLYCATCHERS

Nests. — We found a total of 146 nests in 1999, including 120 on the U-Bar Ranch and an additional 26 on nearby lands of the Gila National Forest, The Nature Conservancy, and other private landowners (Fig. 2). As in previous years, flycatchers used box elder most frequently for nesting (70.3% of nests). Willows (17.8%) and cottonwoods (6.2%) were also used frequently as nest substrates. Flycatchers also placed nests in Arizona alder (3), seepwillow (2), Russian olive, canyon grape, and Siberian elm (1 each). The last two plants have not been previously reported as willow flycatcher nesting substrate in the Southwest.

Substrate use versus availability. — As in previous years, flycatchers did not use substrates in proportion to their availability within the habitat. Flycatchers showed a strong preference for nesting in box elder ($\chi^2 = 123.5$, df = 1, $p < 0.001$). Box elder comprised 32.1% of the woody stems over 1 cm diameter, yet contained 70% of all nests found. Use of cottonwood, Arizona alder, and Russian olive were in proportion to their overall abundance (all $p > 0.5$). In contrast, willows (both species pooled) and all other species combined were used less than expected by chance ($\chi^2 = 10.7$ and 24.3, respectively, df = 1, $p < 0.001$ for both). The two willow species used made up more than 35% of all stems but were used for less than 12% of nests (Fig. 3). We found no flycatcher nests in the shrubby bluestem willow.

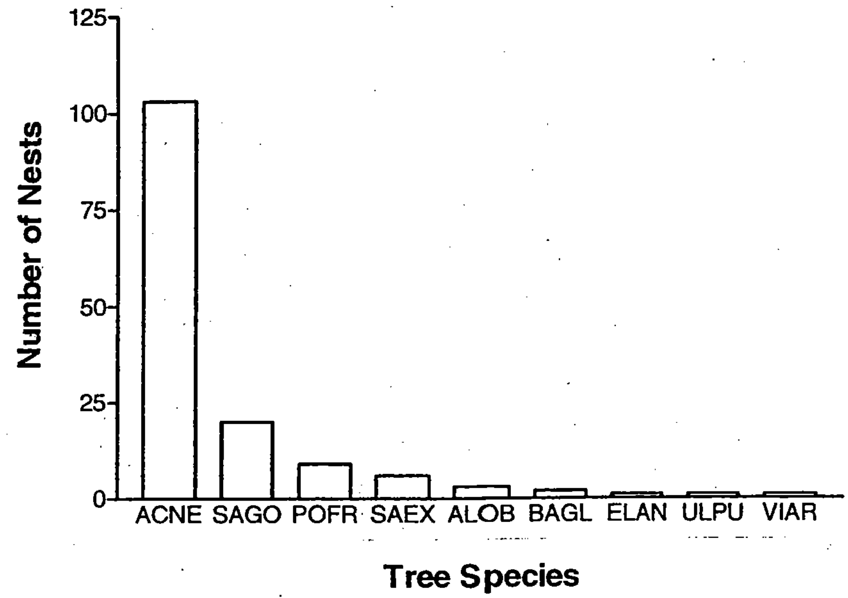

Figure 2. Nesting substrates by southwestern willow flycatchers in the Cliff-Gila Valley, 1999. ACNE = box elder, SAGO = Goodding's willow, POFR = Fremont cottonwood, SAEX = coyote willow, ALOB = Arizona alder, BAGL = seepwillow, ELAN = Russian olive, ULPU = Siberian elm, and VIAR = canyon grape.

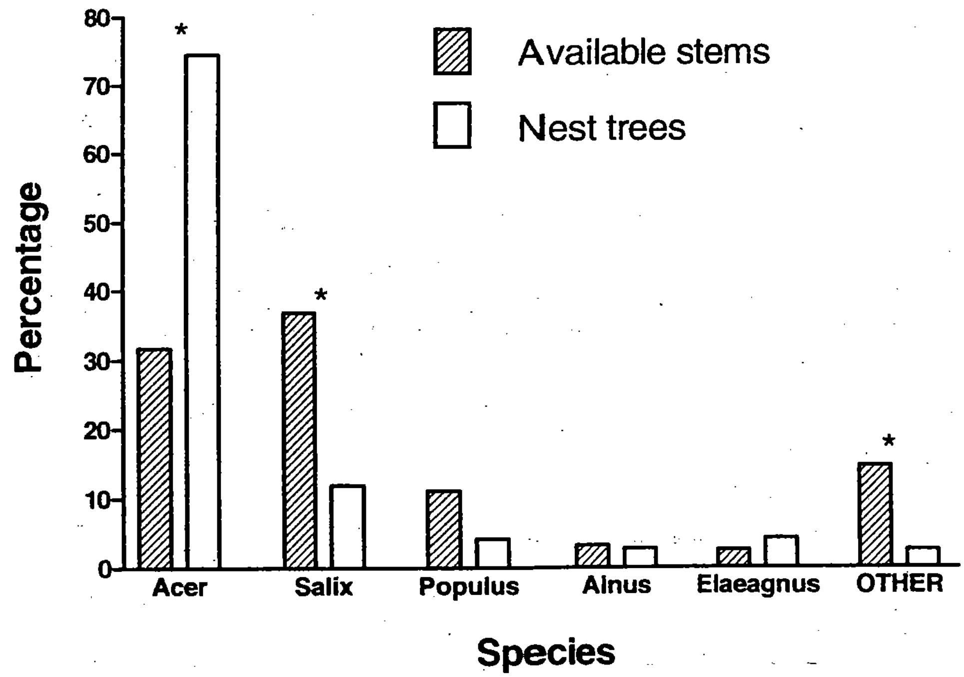

Figure 3. Use versus availability of willow flycatcher nesting substrates. Compared to abundance within the habitat, box elder (*Acer*) was used significantly more, and willows (*Salix*) and all others were used significantly less than expected by chance.

Nest heights. — As in previous years, Willow Flycatchers tended to nest high in the Cliff-Gila Valley. Nest heights ranged from 1.5 to 16.5 m in height, with a mean height of 7.7 ± 3.5 m. Trees and shrubs in which flycatchers built nests averaged 12.1 ± 4.4 m, and ranged from 2.3 to 24.5 m high. As with height, nest trees varied greatly in diameter, from 1.0 cm in coyote willow to 57.5 in box elder (mean = 21.3 ± 13.2 cm). Tree and shrub heights varied greatly among different species, and consequently, nest heights varied among different substrates (Fig. 4)

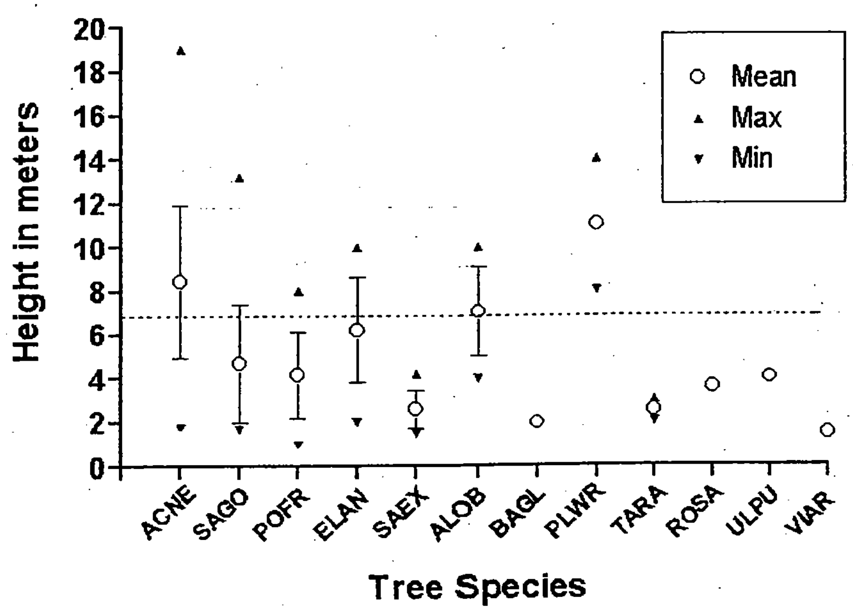

Figure 4. Nest heights (mean, SD, max. and min.) of Southwestern Willow Flycatchers as a function of nesting substrate, based on 403 nests found in the Cliff-Gila Valley 1997-1999. Acronyms as in Figure 1, plus PLWR = *Platanus wrightii*, ROSA = *Rosa multiflora*, TARA = *Tamarix ramosissima*.

In a study of the shrub-inhabiting *E. t. traillii* in Wisconsin, McCabe (1991) measured not only absolute heights but relative heights as well, which he calculated as nest ht/nest plant ht. He found the average relative height in his population to be 62.1 (n = 601); that is, nests were placed 62.1% of the way up the nest plant. In the Cliff-Gila Valley, we found the average in 1999 was 63.9 ± 16.0 (n = 122). Thus, despite the great differences in nest heights (means of 1.4 vs. 7.7 m), the relative vertical placement of nests within the nesting substrate was almost identical in the two populations. Interestingly, we calculated the average relative nest height in native or mixed native/exotic at low-elevation sites in Arizona in 1999 from published data (Paradzick et al. 2000), and found an average of 61.9. Whether this high level of congruence among very different sites is coincidental or not is unclear. Nevertheless, it suggests the possibility that in Willow Flycatchers, absolute nest height may be relatively unimportant compared to the relative nest height within a chosen nest substrate.

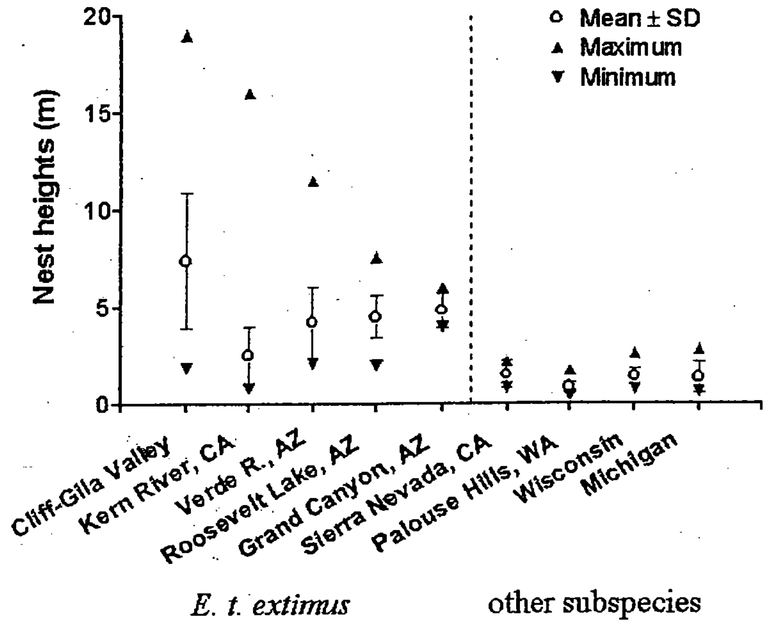

Figure 5. Range of nest heights among populations of Southwestern and other subspecies of Willow Flycatchers, from published data sources. Note that average nest heights are higher in all *extimus* populations than in any population of other subspecies.

Willow Flycatcher nest success. — 1999 was a relatively poor year for nesting by Willow Flycatchers in the Cliff-Gila Valley. Of 128 nests built for which we could determine the outcome, a total of 92 failed (28.1% simple nest success). Numerous nests were abandoned before any eggs were laid, most likely due to wind damage; these probably had little or no impact on seasonal reproductive success by flycatchers. Considering just those nests in which eggs were laid, 69 of 103 nests (67.0%) failed, suggesting a simple nest success rate of 33.3%.

Causes of nest failure. — As in previous years, we were unsure of the cause of most nest failures. Of those we do know, predation was the primary cause of failure for nests in which clutches had been initiated ($n = 24$). Seven nests failed because they were parasitized by cowbirds, and at least four failed due to direct effects of inclement weather (e.g., wind, heavy rain).

Cowbird parasitism. —Of 45 nests for which parasitism status was known, we found seven flycatcher nests that had been parasitized by brown-headed cowbirds (15.6%). At least one of those successfully fledged flycatcher young. In addition, we found two sets of parent flycatchers feeding cowbird fledglings for which no nest was ever found. This is the lowest level of parasitism we have recorded in three years of study.

Willow Flycatcher banding. — In 1999 we placed individually unique combinations of colored aluminum bands on 35 adult and 3 nestling Willow Flycatchers. Of 23 banded individuals of known sex, 13 were female, the remaining 10 males. We recaptured 4 of 31 birds banded in 1998, all approximately where they were first banded. Another 6 individuals banded in 1998 were resighted in 1999, all but one in approximately the same location as in 1998. We observed additional banded birds, but were unable to determine their band combinations definitively. Our sparse recapture data suggest that flycatchers at this site may exhibit strong site fidelity (unlike that reported from Arizona by Paxton et al. 1997).

Impacts of Cattle Grazing and Irrigation on Willow Flycatchers

Because of the concern over grazing impacts on riparian areas generally, and on Willow Flycatchers in particular, we tested several predictions using existing data on flycatcher populations and nesting success in the Gila River Valley, along with knowledge of grazing management on the U-Bar Ranch. On the ranch, 7 of 21 patches have been excluded from grazing since 1993 (exclusive of trespass cattle); the remainder are grazed primarily during the fall and winter. Additional information comes from ungrazed areas of the Gila National Forest and The Nature Conservancy. We compared average values of flycatcher density, nest success, and cowbird parasitism between patches that are grazed for at least part of the year ($n = 15$), and patches that are excluded from grazing ($n = 11$). Analyses of nest success and parasitism include nests on Forest Service and Nature Conservancy properties. We also compared the per-patch density of flycatchers between patches on the U-Bar associated with an irrigation ditch ($n = 14$) and those not ($n = 7$). All analyses include data from 1997-1999. It must be noted that these are *not* experimental tests of hypotheses, but rather correlative analyses, and therefore causation cannot be inferred. Further, as grazing and water management practices may differ elsewhere, it is unknown what their effects on flycatchers might be.

Effects of grazing on Willow Flycatcher densities. -- Grazing had no apparent impact on flycatcher density on a per-patch basis. The average density (pairs/ha) of breeding Willow Flycatchers did not differ significantly between grazed patches and those excluded from grazing ($t = 0.87$, df=1, $P = 0.40$; Fig. 6).

Effects of grazing on Willow Flycatcher nest success. – We detected no effect of grazing on nest success (Fig. 7). The proportion of nests of known outcome that produced young was similar between nests in grazed patches (37.4%, $n = 227$) and ungrazed patches (43.6%, $n = 101$; $\chi^2 = 1.1$, df = 1, $P = 0.30$). The slight difference is not statistically significant. If the nonsignificant trend reflects real albeit subtle differences, those differences may result from differences in density (see Fig. 6) rather than any impacts of grazing. Experimental data are required to assess this.

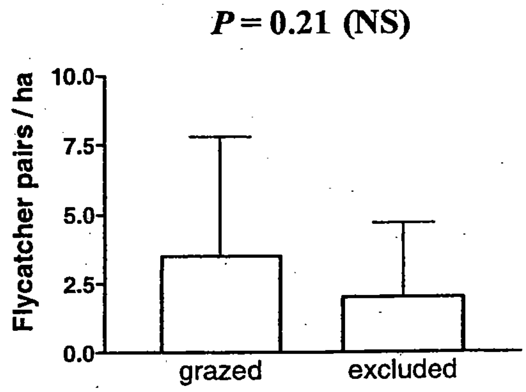

Figure 6. Flycatcher densities in riparian patches excluded from cattle versus patches grazed by cattle, based on population estimates from 1999 survey data.

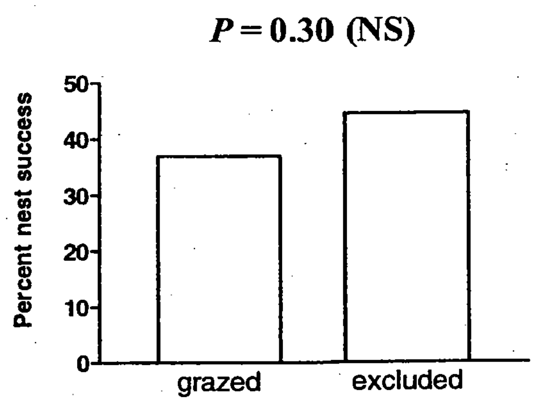

Figure 7. Average success of Willow Flycatcher nests from riparian patches open to cattle and patches excluded from cattle.

Effects of grazing on Willow Flycatcher nest parasitism. – Similarly, we detected no effect of grazing on the likelihood of nest parasitism. The proportion of nests that were parasitized in grazed patches (19.0%, n = 124) was almost identical to that in ungrazed patches (20.0%, n = 46; $\chi^2 = 0.01$, df = 1, $P = 0.91$; Fig. 8). It should be noted that for few of the nests in grazed patches were cattle in the patch while the nest was active. Thus, we find no evidence that livestock grazing, as practiced on the U Bar, has any detectable effect on Willow Flycatchers.

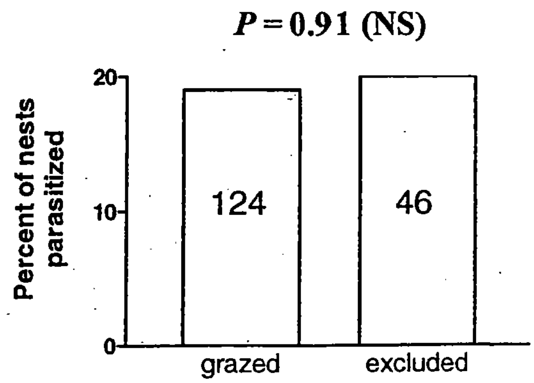

Figure 8. Average rates of cowbird parasitism of Willow Flycatcher nests in riparian patches grazed by cattle and excluded from cattle.

Effects of irrigation on Willow Flycatcher densities. -- In contrast to grazing, irrigation ditches did appear to have a pronounced effect on Willow Flycatcher density (Fig. 9). The density of breeding territories was significantly greater in patches associated with ditches (3.7 ± 4.3 terr/ha) than in patches not associated with ditches (1.3 ± 1.8 terr/ha; Mann-Whitney U = 26.0, 1-tailed $p = 0.04$). This result suggests that the small-scale diversion irrigation as practiced in the Cliff-Gila Valley may increase the quality of riparian habitat for flycatchers, presumably through increases in the extent and degree of hydration.

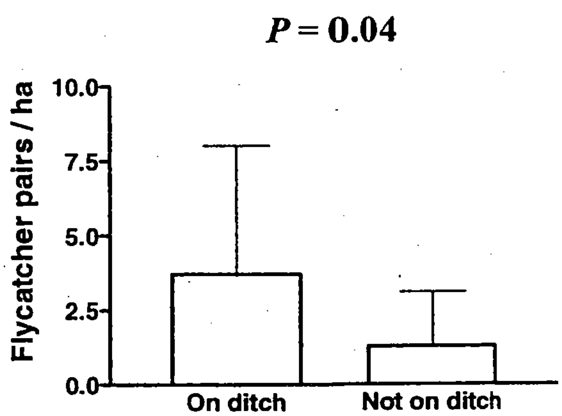

Figure 9. Average densities of Willow Flycatchers in patches associated and not associated with irrigation ditches, based on 1999 population survey data.

Habitat Analyses

Here we present updated assessments of microhabitat use by Willow Flycatchers based on vegetation data collected from 1997-1999.

Comparisons of used versus unused sites. — Microhabitat around Willow Flycatcher nest sites differed from that at unused sites within occupied patches. In univariate comparisons, 13 of 19 habitat variables differed significantly between the two types of plots (Table 2). Willow Flycatcher nest sites typically had greater and less variable canopy cover, less ground cover, canopy height, greater foliage density at both the shrub and subcanopy levels, greater foliage height diversity, more stems of shrubs, trees, and box elders; and fewer stems of cottonwood. Nest plots did not have significantly more willow stems than unused sites. Foliage density was significantly more patchy around nest sites than at unused sites. Nest sites were significantly closer to water, on average, than unused sites (Table 2).

Table 2. Univariate comparisons between Willow Flycatcher nest sites and unused sites of continuous habitat variables. Boldface values indicate differences are significant ($p \leq 0.05$).

Variable	Nest sites ($n = 127$)	Unused sites ($n = 89$)	Test statistic[a]	df	p
Average ground cover (%)	30.0 ± 23.4	39.2 ± 19.3	$t = 3.17$	208.4	**0.002**
C.V. ground cover	0.99 ± 0.49	0.74 ± 0.42	$t = 1.28^b$	214	0.20
Average canopy cover (%)	88.7 ± 7.9	78.8 ± 12.4	$U = 2641.0$		**<0.001**
C.V. canopy cover	0.11 ± 0.11	0.22 ± 0.16	$U = 4952.0$		**<0.001**
Ave. canopy height (m)	13.9 ± 4.7	17.4 ± 9.7	$t = -0.22^b$	150.5	0.83
C.V. canopy height	0.31 ± 0.15	0.38 ± 0.25	$t = 2.46$	135.5	**0.015**
Foliage density 1-3 m	11.4 ± 12.6	13.8 ± 6.3	$t = 2.87$	214	**0.005**
Foliage density 3-10 m	41.7 ± 12.6	25.9 ± 13.7	$t = -8.76$	214	**<0.001**
Foliage height diversity	1.48 ± 0.16	1.14 ± 0.21	$t = -2.42$	157.9	**0.017**
Foliage density patchiness	1.34 ± 0.05	1.29 ± 0.13	$U = 3573.0$		**0.001**
Total of shrub stems (< 10 cm)	29.3 ± 44.5	19.7 ± 25.6	$U = 5535.0$		**0.009**
Total of tree stems (≥10 cm)	9.8 ± 4.7	5.8 ± 3.6	$t = -4.69^b$	146.1	**<0.001**
Total of box elder trees	6.0 ± 4.1	1.6 ± 2.6	$t = -6.10^b$	214	**<0.001**
Total of willow stems	9.9 ± 37.9	3.7 ± 8.0	$U = 8023.0$		0.61
Total of cottonwood stems	0.48 ± 1.74	1.61 ± 3.40	$U = 6911.0$		**0.002**
Plant species diversity	0.60 ± 0.47	0.68 ± 0.47	$t = 1.26$	214	0.21
No. of woody plant species	2.98 ± 1.71	2.92 ± 1.52	$t = -0.28$	214	0.78
Distance to nearest water (m)	41.2 ± 53.8	63.0 ± 58.9	$t = 2.83$	214	**0.005**
Distance to nearest edge	9.9 ± 8.6	9.7 ± 7.0	$t = -0.18$	423	0.86

[a] *t*-tests when data met assumptions of normality, Mann-Whitney U-Tests when data could not be normalized.
[b] *t*-test performed on values transformed to meet assumptions of normality.

Used sites also differed from unused sites in the presence or absence of certain species of common understory herbaceous plants. Nest points were significantly more likely than unused points to have wetland forbs such as spearmint (*Mentha spicata*; $\chi^2 = 4.4$, df = 1, $P = 0.03$) and nettles (*Urtica dioica*; $\chi^2 = 9.0$, df = 1, $P = 0.003$). In contrast, unused points were significantly more likely to have horehound (*Marrubium vulgare*; $\chi^2 = 5.3$, df = 1, $P = 0.02$), four o'clocks (*Mirabilis* spp.; $\chi^2 = 16.8$, df = 1, $P < 0.001$), jimsonweed (*Datura wrightii*; $\chi^2 = 6.0$, df = 1, $P = 0.02$) and morning glories (*Convolvulus* spp.; $\chi^2 = 28.4$, df = 1, $P < 0.001$), all plants typical of dry soils and/or edges.

Habitat variables found to differ significantly in univariate comparisons between nest and unused plots were included in a logistic regression model. When pairs of variables were significantly correlated (at $r > 0.5$, $P < 0.05$), we included the one variable we felt was more biologically meaningful. The logistic regression model (Table 3) with greatest predictive power identified foliage density in the subcanopy, number of box elder stems, and canopy cover as the best predictors of Willow Flycatcher use within occupied patches. The model correctly classified 88% of the nest plots, 81% of the unused plots, and 85% of all plots.

Table 3. Habitat variables found to be significant ($p < 0.05$) predictors of Willow Flycatcher use in a logistic regression analysis.

Variable	β	df	S.E.	Wald χ^2	P
Foliage density 3-10 m	1	0.08	0.018	17.42	< 0.001
No. box elder tree stems	1	0.33	0.070	22.06	< 0.001
Ave. canopy cover	1	0.08	0.025	10.71	0.001
Constant	1	-12.39	2.45	25.59	< 0.001

FUTURE PROJECT GOALS

In 2000, we intend to focus increasingly on characterizing Willow Flycatcher habitat at larger spatial scales. That is, we will determine which attributes of habitat patches and landscapes influence flycatcher presence and nesting success. We will also continue to band birds and begin to analyze patterns of within-site movement, site fidelity, and survival. Preliminary reports from small, mostly ephemeral populations in Arizona suggest relatively low levels of site and even mate fidelity (Paxton et al. 1997). Our limited observations of banded individuals on the U Bar suggest this may not be true in prime habitat.

CONCLUSIONS

Willow Flycatchers in the Cliff-Gila Valley exhibited relatively poor nest success in 1999, perhaps due at least in part to the severe weather extremes experienced during the breeding season. Estimated rates of cowbird parasitism were the lowest we have found in three years (15.6%). Nest site selection was similar to that in 1997-98, with flycatchers demonstrating a significant preference for box elders and avoiding willows. Again, flycatchers tended to nest very high. When data from other nesting sites in the Southwest are compared with data from other subspecies, it appears that *E. t. extimus* is consistently more arboreal in its nesting habits than are other subspecies. This apparent trend may be explained by availability of nesting substrates, if woodland riparian areas in the Southwest provide more suitable habitat than do shrubby sites. Alternatively, nest placement may be influenced by microclimatic considerations: in the arid Southwest, high nests may provide more suitable temperature or humidity conditions for nesting than may be available in lower, shrubby vegetation.

Comparisons of flycatcher nest sites with unused sites within occupied habitat patches revealed differences among almost all habitat variables examined. Notably, foliage density in the shrub layer (0-3 m) tended to be lower around nest sites than around unused sites. The most important of these, as indicated by a logistic regression, were canopy cover, number of box elder trees, and foliage density in the subcanopy. Comparisons of flycatcher numbers and nest success among habitat patches on the U Bar revealed no negative impacts of grazing on flycatchers, and positive impacts of ditch irrigation.

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